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Gasohol—A Critical Choice

"Alcohol can be manufactured from corn stalks and from almost any vegetable matter capable of fermentation: growing crops, weeds—even the garbage from our cities. We need never fear the exhaustion of our present fuel supplies so long as we can produce an annual crop of alcohol."

That's what Alexander Graham Bell said before a high school graduating class in Washington, D.C. in 1917. The idea is old and nearly universal. It appeared with the depression when farmers could not sell their products, and reappeared with each succeeding recession and fall in grain prices. The logic made sense: the technology was there; alcohol was easily made by fermenting grain or other plant material, and it could be used for fuel either alone or in combination with ordinary gasoline. The mixture (in a 90 percent gasoline, 10 percent alcohol combination) is gasohol. But gasoline was cheaper than alcohol, and readily available. And Americans adopted gasoline.

Now, Americans don't have enough fuel. In 1977, they drove 113.7 million cars 1.12 trillion miles and burned 80.2 billion gallons of gas—and the number of cars, miles, and gallons is rising every year. And once again, gasohol is a potential solution. The key word is potential.

Alcohol costs more to make than gasoline. Ethanol (alcohol which can be made from grain and other biomass) costs significantly more than gasoline, depending on the price of the grain. It takes energy to make the change from plant matter to alcohol, and then to mix the alcohol with the gasoline. In addition, the production of alcohol to make gasohol for the U.S. would require systems similar to those required to make gasoline—transportation of raw materials and of alcohol, for example; and indirect costs: taxes, profit, interest on debt, and the costs associated with creating, transporting, and marketing a substance that is both flammable and federally controlled. And the costs of the physical plants would be considerable. To produce enough alcohol to make gasohol for the entire country, it would take 10 billion gallons of alcohol—the combined production capacity of 500 facilities, each producing 20 million gallons per year.

But with all of these costs, there are benefits. Distillers dried grain, a by-product of the ethanol-producing process, is a fine, high protein animal feed. Ethanol enhances the octane rating of gasoline, and this alleviates the problem of engine knock. Gasohol reduces some carbon monoxide emissions and, according to some scientists, can produce better mileage than straight gasoline. And, with increased technology, some scientists are confident that methods can be developed to produce alcohol using no more energy than is contained in the alcohol.

There are other unresolved areas: large quantities of grain, if diverted from the export market to produce alcohol, could affect the welfare of countries which depend on American agriculture for their food. A well-meaning but ineffective tax incentive system to promote gasohol might benefit shrewd investors more than America's farmers. Finally, if more energy from oil or natural gas were used in producing gasohol than is contained in the gasohol, farmers could end up spending more, not less, in increased costs for fertilizer, feed, or fuel. These are

(Continued on p. 16)

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COVER: A graphic drawing of a stable fly, similar to those eliminated for 6 months during an integrated pest management (IPM) project on the Island of St. Croix. Design by Art Cushman. (BN-38084). Story begins on page 6.

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Bob S. Bergland, Secretary
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A female Osmia cornifrons backs into a straw to deposit pollen for her offspring. The female bee lays as many as 10 eggs in each straw during her 6-week lifespan (PN 4187).

New Bee . . . for Small-scale Farmers

A NEW IMPORT from Japan, a species of bee called *Osmia cornifrons,* now under study at the Beltsville Agricultural Research Center, may help solve pollination problems for homeowners and small-farm fruit tree growers.

Large-scale fruit growers maintain their own bee colonies or rely on commercial keepers to supply bees as needed for pollination. But this costs money and is economically impractical for small orchards—50 trees or so—and for homeowners with only a couple of trees. Also, honey bees usually involve several problems. They suffer from diseases and predator pests; they swarm; sometimes they abscond; they require considerable attention; and sometimes, often once is too much, they sting.

However, most of this doesn't apply to *O. cornifrons.* About two-thirds the size of a honey bee, the little insect has a lot of pluses which make it ideal for small-scale fruit-growing operations. The adults are shortlived and don't have to be managed the year around; they produce no honey or beeswax which makes them less susceptible to certain diseases and damaging insects that afflict honey bees; and they are more active than other bees when temperatures are cooler. This means they can fly and pollinate earlier. Generally their life cycle is in tune with fruit tree blossoming; they store no honey so marauding honey bees leave them and their nests alone; they rarely range more than 100 yards from their nests; and on top of all this, the little insects are extremely docile.

Males can't sting; females rarely do, and then only if highly provoked. But the sting parallels that of a mosquito bite with about the same after-itch. Consequently, these bees are very safe to work with, and children, or anyone for that matter, can watch close up and in relative safety these little wonders of nature do their thing.

The Beltsville study began in 1977 after research entomologist Suzanne Batra successfully imported 600 of the bees from Japan's Tohoku National Agricultural Experiment Station. *O. cornifrons* have been used for apple tree pollination for more than 30 years in some northern areas of Japan. Batra has named the bees "hornfaced osmia" because of the horn-like protrusions on their faces. Since the 1977 shipment, Batra has successfully nurtured the bees through two winters and the colony now numbers about 2,500—ample for her current pollination experiments. She makes sure the bees have adequate nourishment, a diet of fruit tree and blueberry flowers, and wildflowers. She monitors their health closely, sometimes using a microscope to check them for parasites or disease; and provides nesting materials including the mud the bees use to make compartments in their nesting sites.

Batra points out that her charges are quite different from honey bees. *O. cornifrons* in nature nest in hollow reeds or any hole long enough with a certain diameter. Batra's bees nest in bundles of common soda straws with each bee having its own straw. The male bees, which live and mate for about 4 weeks, are the first to appear. In

early April, they emerge and begin pollinating in their search for food. About a week later, the females emerge and mating is accomplished during the following week. Then the females, while continuing to collect and store pollen, begin to lay eggs in their individual straws.

First the mother puts in a mixture of pollen and honey, lays an egg, then builds a mud wall to separate the egg from the next. One egg—one chamber, and so on until the tubular condominium is filled. Then she proceeds to fill another straw. Each straw holds about 5 to 10 chambers. The female dies after a relatively short, but work-filled 6-week lifespan. The baby bees develop in the straws and hibernate over the winter until they emerge as adults in the spring.

A point of interest about the horn-faced osmia society is that there are no queens. Numbers of males and females are about equal even though the male is not monogamous. His primary role is mating. The female handles the rest. She even determines the sex of the progeny. After mating, she retains the male sperm and fertilizes only those eggs she wants to become females. Unfertilized eggs hatch out males. Interestingly, it's the eggs laid last in the straws that are unfertilized, which accounts for the initial emergence of males in the spring.

Batra's first experimental objective was to determine what was needed for bee survival. Previously, USDA scientists had tried to establish *O. cornifrons* at the Bee Biology and Systematics Laboratory in Logan, Utah. But the bees couldn't survive Utah's rigorous winters. The second objective is to evaluate pollinating activity during the season, and finally, to determine which fruit trees the bees would most effectively pollinate.

"So far, so good," says Batra, "it seems that the East Coast climate with its higher humidity agrees with the bees. And the bees seem to be aggressive foragers which is good for pollination."

In the initial experiments, the bees appear to effectively pollinate apples, plums, apricots, peaches, cherries, blueberries, and some varieties of pears. Batra says, "As soon as the colony is large enough, I hope to extend the range of the experiments to locales as far north as the apple-growing country in midstate New York and as far south as the peach areas of Georgia."

H. "Bud" Kerr, Northeast Region coordinator of small-farm research for SEA–AR, says, "Because of their relatively short operating range, these bees are not too practical for commercial operations, but they're ideal for lesser activities. They could be a fun and practical bee for small orchards."

Chief of the Beltsville Beneficial Insect Research Laboratory, Jack Coulson, credits much of the experiment's success to Batra's constant care of the bees. He said, "She makes sure they're provided with food and shelter, shaded from the hot summer sun, and protected from other insects and insecticides. Her work so far shows that *Osmia cornifrons* can survive in the United States and that they are a valuable beneficial insect. I feel that it may only be a question of a few years before these bees will be widely accepted and used."

Dr. Batra's address is Bldg. 417, Beltsville Agricultural Research Center, Beltsville, MD 20705.—*L.W.S.*

Suzanne Batra keeps track of her bee population by painting the underside of each straw containing Osmia cornifrons eggs. Come springtime, she will know which straws the bees will emerge from in order to check their development and insure an accurate population count (579A595–17).

MEASURING FAT IN MEAT

THERE are only two official ways to determine fat content in meat and meat products according to the Association of Official Analytical Chemists (AOAC).

One procedure takes 6 to 8 hours; the other requires relatively sophisticated equipment costing from $6,000 to $8,000. Both measure only crude (neutral) fat content. These are the only two methods presently used by government regulatory agencies, analytical laboratories, state agricultural experiment stations, and meat processors.

A method developed at SEA's Eastern Regional Research Laboratory in Philadelphia, may change these procedures.

The method developed by chemists Robert J. Maxwell, William N. Marmer, and Marta P. Zubillaga, and by trainee Gail Dalickas, is rapid, accurate, and inexpensive—equipment costs less than $30.00. The technique offers an important advantage over present procedures. Total fat, both neutral and polar, is measured precisely.

Though official status by AOAC awaits further study, the process can be used for nonofficial purposes. Packinghouse operators can use it to get quick, accurate readings on fats in meats and products such as ground beef, frankfurters, and sausage. Nutritionists needing to know the percentages of all meats also will find the new method useful.

Both official methods require costly and sophisticated equipment. Except for a balance for weighing needed in all methods, the new process requires only a mortar, a pestle, and a simple glass chromatography column. Another advantage to this method is safety. A nonflammable and relatively nontoxic solvent mixture is used for extraction.

The procedure is simple. A preweighed meat sample—5 to 10 grams—is ground in a mortar together with a mixture of anhydrous sodium sulfate and diatomaceous earth. The resulting granular powder is tamped into place in the glass column. The fat is stripped from the powder with a dichloromethane/methanol solvent. Then the solvent containing the dissolved fat is collected in a beaker, and the solvent removed. The fat is weighed, and the weight expressed as the percentage of fat in the sample. The entire process, from start to finish, takes less than 90 minutes.

The research group has also used the method to find the fat content in other foods including milk, ice cream, butter, eggs, fish, and legumes. The team also is studying the possibility of using their "dry column" method as an alternative to the classical extraction techniques used in biochemical studies.

Conventional methods now require several days to isolate unaltered fat from tissue and to separate the fat into its various subclasses. The researchers are testing a variation of their procedure—using sequential elution (washing out) first of neutral fat and then of polar fat—to achieve complete isolation and separation in less than 2 hours.

The address of the Eastern Regional Research Laboratory is 600 East Mermaid Lane, Philadelphia, PA 19118.—*L.W.S.*

LABELING FOOD FATS

RESEARCHERS in nutrition and medicine have a new tool for studying the role of food fats in human nutrition and health.

Using the tool developed by chemists at the Northern Regional Research Center, Peoria, Ill., researchers can determine how a healthy person's body uses the different fats found in vegetable oils.

The tool is actually a technique for distinguishing fat components changed by hydrogenation of a food oil from components that have not been changed. Since the technique attaches distinguishing nonradioactive atomic labels to almost identical fatty components of food oils, it is called multiple labeling.

The technique is based upon differences among the weights, or masses, of the fats. These differences in mass are chemically introduced at the atomic level and are detectable in an instrument, the mass spectrometer.

"The advantage of multiple labeling," said Edward A. Emken, research leader at the Center, "is that two or more specific fatty acids can be compared directly to each other in the same healthy person." Before the multiple labeling technique was developed, scientists could study compounds with radioactive labels in animals and in terminally ill volunteers.

Researchers can feed the labeled fats safely to a volunteer and find them later in the person's blood fractions. This enables the researchers to compare the ways the subject's body has used the almost identical fats.

Fatty acids are components of vegetable oils. Americans eat almost 6 billion pounds of hydrogenated vegetable oil every year in margarines, salad oils, cooking fats and shortenings. About 90 percent of this is soybean oil. It is hydrogenated to make it more solid at room temperature or to preserve its flavor during storage and use.

Hydrogenated fats have been studied in animal metabolism and implicated in undesirable effects such as high cholesterol levels, fragile cell membranes, and altered metabolism.

"Research with human subjects has been limited and contradictory," Emken said. "Some studies have indicated only small or no increase in serum cholesterol and triglyceride (fat) levels due to dietary hydrogenated fats, but others have found significant increases."

The address of the Northern Regional Research Center is 1815 N. University St., Peoria, IL 61604.—*D.H.M.*

The Flies Stopped Biting...

for Awhile

A PEST control research study, integrating the sterile male technique with other control methods, eliminated 99.9 percent of the wild stable fly population on St. Croix Island for 6 months.

SEA researchers from the Insects Affecting Man and Animals Research Laboratory say that, despite some setbacks, the study proved that an integrated pest management program like the one developed on St. Croix can control stable flies on a large and diversified land area. During the 3-year study period, they also learned how to integrate sterile-male releases into a total insect control program using limited equipment and a small staff.

A 99.9 percent control of the target pest for a 6-month period was a remarkable result considering the many adverse conditions the research team encountered. They had overcome many problems on a diverse island that supports about 1,000 dairy animals, 8,000 cattle, and 1,000 horses. They had discovered more than 100 major fly breeding sites, and approximately 1,000 backyard areas also considered as pest breeding areas.

St. Croix is an isolated land mass in the Virgin Islands of roughly 80 square miles, and is slightly over 40 miles down-wind from the nearest island having a large population of wild stable flies. The flies can migrate up to 70 miles, and could also enter the island on incoming ships with cattle, so total elimination was not considered possible during the research period.

The island has two definite seasons—a wet fall season when wild fly populations are greatest and a dry summer season when pest populations decline. The island's weather and fly breeding locations—such as in sorghum silage mixed with animal wastes—are similar to areas in northwest Florida where the flies are a serious pest of the cattle and tourist industries.

St. Croix has 3 distinct areas: a dry desert; a partially inaccessible mountainous rain forest; and a fertile central plain where farms and the island's human population are concentrated.

The budget and plans for this study did not include airplane release of the sterile flies so the whole island was never covered from end to end. Since the sterile flies bite and suck blood from people as well as animals, no mass releases were made in the towns and villages.

During the first year and a half of the study, the researchers surveyed the wild fly population, developed methods to monitor changes of that population, and worked out ways to create a colony of mass produced flies to be sterilized. All sterile flies were dusted with fluo-

rescent powder for later identification with ultraviolet light as a part of a planned evaluation program.

Methods also were developed for daily releases of the flies using paper bags holding 4,000 flies at spots along roadways, and letting 12,000 flies loose from screened cages on farms. Once the sterile-males from the colony had mated with wild females, these females produced no offspring, thus reducing the wild population.

The colony breeding program suffered a setback at one point when a new shipment of bran, used as a growing medium for the insects, was slightly changed in texture—changing the amount of moisture it would hold. High heat, ammonia buildup, and predator control in the colony production area were similar problems faced by the research team.

During the study's last year and a half, the average colony production was held at about a quarter of a million flies each day, at an average cost of $300 per million flies. That figure does not include housing and some of the original equipment gathered for the mass rearing facility.

The other stable fly control methods integrated with the release of the sterile-males included: an ongoing cattle dipping program to control ticks; treatments of major breeding sites with a 1 percent spray of methoxychlor; some cultural control methods; releases of house and stable fly parasites in a caged layer operation of about 20,000 chickens; and an attractant toxicant panel used during the last 6 months of the study on several farms.

At the end of the integrated control study, as expected, the wild population levels of the pest returned as strong as ever in about 3 generations. But, for 6 months, the citizens and visitors to St. Croix enjoyed a nearly pest-free time without battling biting stable flies. Dr. Donald Weidhaas' address is P.O. Box 14565, Gainesville, FL 32604.—*S.S.*

Short–Season Cotton Cuts Costs

Conventional cotton production systems (160 to 180 days) became much less profitable in the Lower Rio Grande Valley of South Texas during the early 1960's. At that time the tobacco budworm [(*Heliothis virescens*) (F.)] became resistant to insecticides being used. Conventional cotton production harvesting also coincided with the rainy season, threatening the cotton bolls with rot.

Researchers sought to surmount these problems by field-testing an integrated short-season (130 to 140 days) production system which included using short-season cultivars and overwintering boll weevil population control. The advantage of short-season cotton is that it can be harvested before insect populations peak and damage the cotton crop.

Short-season cultivars, "TX–CAMD–E," "Tamcot SP–37," and "McNair 220," were compared with a conventionally grown cultivar, "Stoneville 213," under short-season management and traditional longer season production systems in fields of nearby growers. The fields of these growers were used as controls in the experiments.

The experiments were conducted on four hectare plots. Cultivars within the plots were planted in 0.8 hectare blocks. Seven plots were planted in 1976, five in 1977, and four in 1978.

Average mean yields for the short-season cultivars were 791 kg/ha for "Tamcot SP–37," 894 kg/ha for "McNair 220," and 794 kg/ha for "TX–CAMD–E." The conventionally grown cultivar, "Stoneville 213" yielded 670 kg/ha. Experimental control fields of nearby growers averaged 644 kg/ha with "Stoneville 213."

After two early season sprayings of azinphosmethyl for overwintering boll weevil control, only an average of four additional sprayings were required for short-season cotton. The conventionally grown 160 to 180 days) cotton on grower plots required 10 sprayings. Less irrigation water was also required in both medium- and fine-textured soils with the short-season production system.

The cost of producing a kg of lint in 1978 under the short-season production system was 86 cents (39¢/lb.), compared to 121 cents (55¢/lb.) for lint produced with conventional production practices. With increased yields and decreased production inputs, the short-season production system is an excellent alternative to current production practices used in the Lower Rio Grande Valley of South Texas.

The research was conducted by Dr. M. D. Heilman, Dr. L. N. Namken and Dr. M. J. Lukefahr at SEA's Soil and Water Conservation Research Laboratory, P.O. Box 267, Weslaco, TX 78596, and J. W. Norman of the Texas A&M Extension Service, Weslaco.—*E.L.*

Above: Ann C. Vorwald, biological lab technician, prepares a piece of fetal tissue for sectioning. She will use immunofluorescence microscopy to examine the tissue for evidence of PPV (0479X451–36a).

Right: Randall Cutlip and Talmage Brown examine cell cultures infected with PPV (0479X449–28).

Vaccine Prevents PPV in Pigs

An experimental vaccine administered to gilts before they are bred prevents porcine parvovirus (PPV) infection of their litters, should the gilts be exposed to virulent virus during gestation.

Development of the inactivated vaccine is the latest in a series of research advances in control of a serious swine disease unknown in the United States before 1971. It was then that SEA veterinary medical officer William L. Mengeling reported the presence and common occurrence of PPV infection in this country's hogs.

European scientists reported isolation of PPV from mummified and stillborn pigs in the late 1960's. Research by Mengeling and associates at the National Animal Disease Center in Ames, Iowa, indicates PPV is also a major cause of abnormally small litters.

The development and effects of PPV infection were not well understood when the SEA scientists began their studies. Their research has now filled gaps in knowledge of the disease: the virus may be transmitted in a variety of ways, infection occurs without maternal clinical signs, effects depend upon stage of pregnancy when a gilt is exposed to PPV, diagnosis with a fluorescent antibody test is reliable, and an acetylethyleneimine-inactivated PPV vaccine protects against reproductive failure.

Mengeling and SEA veterinary medical officers Talmage T. Brown, Prem S. Paul, and Donald E. Gutekunst demonstrated that their experimental vaccine is effective and safe.

They vaccinated gilts intramuscularly before breeding, then exposed the gilts

Mengeling prepares to test experimental porcine parvovirus (PPV) vaccine (0479X450–36).

by nose and mouth to virulent PPV at about the 40th day of gestation.

Neither PPV, viral antigen, nor specific antibody were found in any of the fetuses when the vaccinated gilts were killed about the 84th day of gestation. Conversely, most fetuses of nonvaccinated gilts, which were otherwise treated similarly, had died of PPV infection by the same stage of gestation.

Safety of the vaccine, which may serve as a model for one developed commercially, was demonstrated two ways. Nonvaccinated gilts kept in contact with vaccinated gilts remained free of infection until after they were exposed to PPV. And boars, which were used to breed the vaccinated gilts, likewise remained free of infection. The vaccine did not inadvertently produce disease.

Need for a protective vaccine was evident when SEA scientists confirmed the suspected link between PPV and reproductive failure in hogs and also determined incidence of the virus in hogs at slaughter.

Mengeling and SEA veterinary medical officer Randall C. Cutlip produced the first direct evidence that PPV causes reproductive losses in U.S. swine. They found large amounts of PPV antigen in tissues of six mummified fetuses recovered from a gilt, as well as specific antibodies to the virus in the blood serum of a normal-appearing fetus of the same litter.

Two studies reinforced Mengeling's 1971 report on distribution of PPV in the Nation's hogs. He and Cutlip detected antibodies for PPV in 51 percent of a group of butcher hogs surveyed in one study. In Mengeling's later study,

Column chromatography is used to purify immunoglobulins produced by fetal pigs infected with porcine parvovirus. Here Prem Paul and Karen Halloum, biological lab technician, test another sample (0479X451–13).

dead fetuses or embryos were carried by 97 of 394 sows and gilts pregnant 60 days or more at slaughter. PPV was the probable cause of death in 63 of the 97 litters.

PPV may be transmitted intranasally or orally, Mengeling says. The virus also has been found in boar semen, indicating the likelihood of venereal transmission. Infection usually occurs in litters carried by gilts; sows often have been exposed to PPV and have developed protective antibodies.

When an unprotected gilt is exposed to PPV during pregnancy, the virus crosses the placenta and may infect part or all of her unborn litter.

Embryos less than about 36 days old will die and be resorbed, the gilt will return to heat, and a subsequent pregnancy is likely to be normal. There is limited circumstantial evidence that should the embryos not be completely resorbed, the gilt may return to heat and accept a boar but not conceive.

Fetal infection between about the 36th and 70th day of pregnancy causes death and mummification of the fetuses. When the gilt neither returns to heat nor farrows at the expected time, she may be sent to market as a nonbreeder without PPV infection being suspected.

Most fetuses are able to produce specific antibody to PPV and survive when infection occurs late in pregnancy.

No outward sign alerts the owner or veterinarian to PPV, Mengeling says. He advises considering the possibility of PPV in any of these situations: an unusually large number of bred females return to heat, they do not return to heat but fail to farrow at the expected time, they have abnormally small litters, or they have a large proportion of mummified fetuses. Tentative diagnosis of PPV can be confirmed by a laboratory test.

Dr. Mengeling is located at the National Animal Disease Center, P.O. Box 70, Ames, IA 50010.—*W.W.M.*

Better Berries for Breeders

PLANT breeders screening for rot-resistant strawberries and red raspberries now can use a new, more precise procedure developed by SEA plant pathologists John L. Maas and Wilson L. Smith.

Preharvest and postharvest rot in strawberries and red raspberries causes multimillion dollar losses annually throughout the industry.

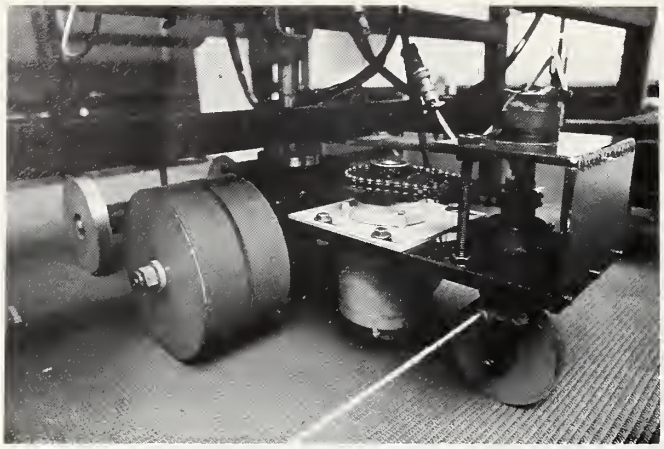
A major cause of rot is the fungus *Botrytis cinerea.* Development of the fungus depends very much on the weather, temperature, and humidity. Since these factors are so variable, previous field screening has not been too effective.

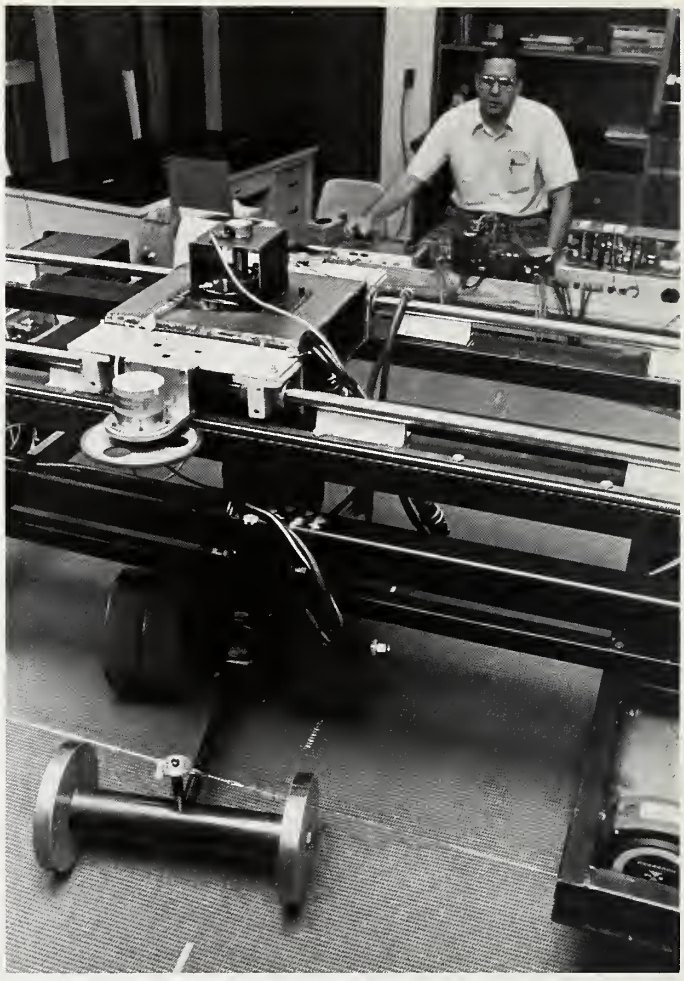
Screening is more reliable and quicker with the Maas and Smith system, a refinement of an approach developed in 1970 by the Canadian Department of Agriculture. The new technique, in which berries are held for 3 days at 18 to 20° C (65 to 69° F) with 90 percent humidity, provides optimum conditions for decay development. Berries from plants with any rot resistance are easily detected.

Until now breeders have had no refined screening techniques that would enable them to measure small differences in clonal resistance. This technique is necessary in order to breed for resistance by successively accumulating low levels of resistance in each breeding cycle.

The researchers suggest that with some modification the technique may provide the basis for similar standardized systems for other fruits.

Dr. Maas is with the Plant Genetics and Germplasm Institute, and Dr. Smith is with the Agricultural Marketing Research Institute, BARC–W, Beltsville, MD 20705.—*L.W.S.*





Above: Field tests have shown that the tractor, here towing a trailer to simulate farm conditions, can follow a predetermined route with a tolerance of 2 inches (1078X1255–13).

Right: Schafer carefully watches the automatic guided tractor move down its track. The invention should help increase crop yields by minimizing soil compaction (1078X1255–21).

The Driverless Tractor

"RESEARCHERS have shown that soil compaction due to vehicle traffic can reduce crop yields, and inadequate steering of field machines often results in unnecessary soil compaction in the plant root zone. One method of confining soil compaction to a small area during multiple field operations is to automatically guide the field vehicles in the same tracts," says agricultural engineer Robert L. Schafer of SEA's National Tillage Machinery Laboratory in Auburn, Ala.

Schafer and Roy E. Young, formerly with the School of Agriculture and Agricultural Experiment Station, Auburn University, have studied steering automation for agricultural vehicles for several years. They have developed a digital electronic controller that has successfully guided a tractor on cotton and soybean fields. Since many basic studies do not require an actual tractor and are more easily and economically done in the laboratory, the engineers constructed a simulator to avoid the time, expense, and difficulty of using an actual tractor.

The research team of Schafer and agricultural engineers Lowrey A. Smith, from SEA's Crop Production and Engineering Research Laboratory, Mississippi State, and Clarence E. Johnson and Steven C. Young, from the School of Agriculture and Agricultural Experiment Station, Auburn University, have expanded the simulator to study computer-controlled steering.

The simulator drives a 1/9-scale model tractor-implement combination on a wide conveyor belt. The tractor is held in a fixed position with only the freedom to move from side to side as it is steered. The belt can move at various speeds, and a computer controls the tractor's steering.

Although adaptation of the simulator for the scale model tractor-implement combination is recent, the engineers have already tested some control concepts for using computers to automatically guide tractors. They see many further opportunities to use the simulator to develop inexpensively the basic concepts of automatic guidance.

The address of the National Tillage Machinery Laboratory is Farm Rd. and Donahue Rd., P.O. Box 792, Auburn, AL 36830.—*B.D.C.*

Cottonseed for Cows

RAPIDLY rising milk prices might be held down by feeding whole cottonseed to dairy cows. Cottonseed increases milk production without significantly increasing farmer feed costs.

Many dairy farmers in the Southwest have been feeding whole cottonseed to their cattle. Dairy cows seem to like the seed, which is fed unprocessed as it comes from the gin, and some farmers have reported gains in milk production. These reports, however, contradict earlier research findings.

A study was conducted at Logan, Utah, to determine the true value of cottonseed as a feed and what was causing any production increase that might be occurring. Conducting the study were SEA animal scientists Melvin J. Anderson and Robert C. Lamb, along with graduate student Donald C. Adams and statistician Jeff L. Walters, both of the Utah State University.

Two tests were run. In the first test, 4 pounds of cottonseed were fed in place of 4 pounds of regular feed (the equivalency commonly used by dairy farmers) to 20 cows and a normal ration of regular feed was fed to 18 cows. The test lasted 56 days.

Cows on cottonseed produced about 3 quarts more milk per day than cows on normal feed diets. Increased energy consumption from more feedings accounted for 75 percent of the production increase, and the cottonseed's usable energy content accounted for the remaining 25 percent. Milk quality remained about the same for both diets.

The second test involved 18 cows and lasted 12 weeks. It compared performances of cows on a diet where 20 percent of the regular feed had been replaced with cottonseed, a diet of regular feed, and a third diet of regular feed with enough extra grain added to supply the same energy as the cottonseed diet.

Once again, cows on a cottonseed diet produced more milk than cows on regular feed, even with the added portion of grain. Production differences, however, were not as great as in the first test. Quality differences were again insignificant.

Even though cottonseed is more expensive than regular feed, feeding cottonseed to dairy cows is economical because the cattle's milk-producing efficiency is boosted sufficiently. So long as cottonseed remains an economical feed, the idea of feeding it to dairy cattle can be practiced anywhere.

Dr. Anderson and Dr. Lamb are located at Room 240, Agricultural Science Building, Utah State University, Logan, UT 84322.—*L.C.Y.*

(Photo courtesy Grant Heilman)

Predicting Water Pollution

A STUDY relating sediment in Minnesota streams to soil eroding from uplands contains information that may help the Nation reach water quality goals. Scientists hope to incorporate the information in a computer program or model that planners can use to develop farm plans for minimizing pollution.

The research at Morris, Minn., by SEA agricultural engineer Charles A. Onstad and a research fellow, Michael A. Otterby of the University of Minnesota, involved computer analyses of nearly 14,000 measurements of sediment in river water. The water samples had been taken from 23 river basins over an 8-year period by the U.S. Geological Survey.

Onstad says that information from the study will be used with ongoing research to quantify water pollution that can be caused by both sediment and chemicals clinging to sediment. A computer could be employed to assist in predicting locations and concentrations of chemicals that remain on a watershed after a storm.

Predictions may help farmers with their decisions regarding agricultural chemical use—decisions on timing, rates, and application methods. Decisions on crop rotations and tillage practices also may come into clearer focus, Onstad says.

Onstad sees farmer involvement in developing farm plans for minimizing pollution as one way the Nation can most economically reach the water quality goals of the 1972 Federal Water Pollution Control Act. He says regulatory agencies should base enforcement of water quality standards on use of an acceptable farm plan rather than try to fix blame for some pollution incident.

"If we want to reduce pollution from a particular watershed by a certain percentage," Onstad says, "it would probably be uneconomical to apply the same pollution control measures over the entire watershed. It may be better to identify parts of the watershed that produce the most sediment and apply conservation practices most intensively there."

In their study, the scientists found wide variations in the effects of erosion on water quality. For example, a particle of loess soil on a farm in southeastern Minnesota's Root River watershed was typically about 20 times more likely to flow in suspension downstream than a soil particle in a forested region of northern Minnesota.

Fine texture of the loess soil, rolling topography, and cultivation in southeastern Minnesota may have considerably influenced the loss of more than 1,000 kilograms of soil per hectare or 900 pounds per acre.

If that doesn't seem like a lot of soil, contemplate that a much greater amount was eroded from farm fields and deposited as sediment before it could reach the river. Also, Onstad said, the study did not include bed load—sediment not in suspension that is rolled or dragged along the stream bottom.

The scientists found that suspended sediment collections in March through June accounted for about 75 percent of the total suspended sediment yield. April alone accounted for nearly 30 percent of the total. In April, spring tillage was underway and heavy rains gave rise to cleaning out of previously deposited sediment in gully channels and streambanks, Onstad explained.

Generally, the dirtiest water flowed downstream in June, when thunderstorms were often severe. Concentrations of sediment in June were more than 4 times greater than those in February and 1.7 times greater than the average for the year, Onstad said.

Average annual concentrations of suspended sediment ranged from 9 milligrams per liter (mg/l) in the Crow River at Nimrod, Minn., to 622 mg/l in the Root River near Lanesboro, Minn.

Dr. Charles A. Onstad is located at the North Central Soil Conservation Research Laboratory, Morris, MN 56267.—*G.B.H.*

AGRISEARCH NOTES

A Still for Research Is Still a Still

IF SOMEONE talked about making stills in Mississippi, you'd probably think of white lightening or chasing "revenooers" through the pines on moonlit nights—the romanticized legacy of the Prohibition era.

SEA scientists have built a still—but not for whiskey. Entomologists Gerald H. McKibben and William L. Johnson need to distill and extract large quantities of plant material to study the boll weevil's response to volatile oil in the cotton plant.

Using a boiling chamber made from an ordinary steam kettle, copper tubing, and a common steel drum for the condenser, the scientists constructed a still that can handle up to 200 pounds of plant material per day. One batch takes about an hour and 15 minutes to distill and produces about 1½ gallons of distillate. The oil is then extracted for studying the response of the boll weevil.

Previous research by McKibben and others has shown that volatile oils from cotton plants attract both emerging and overwintered boll weevils and late-season migrating weevils. The oils apparently attract the migratory boll weevils to other cotton fields in the late summer and fall and also help guide overwintered weevils to fields of seedling cotton in the spring.

The weevil's response to the volatile oils of cotton is part of an overall research project to control and hopefully one day eliminate this costly and troublesome insect that invaded the United States in the late 19th century.

If the project proves successful, not only will time, trouble, and millions of dollars be saved, but also the environment will be spared the impact of the chemicals currently used to fight the boll weevil.

Also, the scientists point out that their design can be used to build stills for distilling plant material other than cotton. Their still is a low-cost, easy-to-build piece of research equipment.

Gerald H. McKibben and William L. Johnson did the research at the Boll Weevil Research Laboratory, Mississippi State, MS 39762.—*B.D.C.*

Soil Stabilizers Aid Water Harvesting

SOIL STABILIZERS that prevent erosion are proving to be an important addition to water harvesting methods.

Water harvesting is a technique of making soil surfaces on mini-watersheds water repellent with the use of certain organic chemicals. Water, falling as rain or snow on small watershed surfaces, is channeled into tanks or ponds for livestock or wildlife use in semi-arid environments.

Such dry areas are limited in the number of animals they will support, more by the lack of water than by the lack of food. Water harvesting is a method of obtaining water without costly hauling or expensive wells.

The technique is being widely used by federal and state agencies and by ranchers throughout the Southwest. Generally, the repellent material being used includes waxes, silicones, or low-grade oils.

Many times, if the soil beneath the repellent materials has not been stabilized, water running across the surface finds a crack or flaw and washes out the site. Soil stabilization eliminates much of that problem.

SEA soil scientist Dwayne H. Fink of the U.S. Water Conservation Laboratory, Phoenix, has found several effective stabilizers that control erosion while preventing water infiltration.

They are cellulose xanthate (a material made from waste paper), aluminum salts like simple alum, and anti-stripping agents used in asphalt highway construction. The stabilizers permit lower repellent application rates. This helps to conserve precious petrochemicals used in water harvesting.

The address of the U.S. Water Conservation Laboratory is 4331 E. Broadway Rd., Phoenix, AZ 85040.—*J.P.D.*

Double Duty for Coffee Can Lids

YELLOW LIDS from coffee cans, when coated with a sticky substance, make excellent and cheap traps for the citrus blackfly, a serious and costly pest to citrus growers.

SEA entomologists Donald P. Harlan and William G. Hart have found, in two tests in grapefruit and orange groves, that traps made from the yellow coffee can lids were "as effective, cheaper, and easier to prepare" than the standard plastic dish trap.

The plastic dish trap must be painted yellow, adding to its expense. The coffee can lid is about the same size and color of the standard dish.

In the two tests, the number of insects trapped by the coffee can lid and the plastic dish traps were not significantly different.

However, each coffee can lid trap costs 10 cents, compared to the 21 cents cost for the standard trap which has been used for several years at the Citrus Insects Research Laboratory.

When computing the costs of traps that number in the tens of thousands, savings could amount to thousands of dollars per year.

Harlan says that the new coffee can lid traps are now being used for studies in Texas, Florida, and Mexico.

Dr. Harlan and Dr. Hart are with the Citrus Insects Research Laboratory, 509 W. Fourth St., Weslaco, TX 78596.—*B.D.C.*

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Gasohol—A Critical Choice—Continued

not problems yet. Still, gasohol is a multifaceted issue, with each part inextricably related to the others.

In addition, difficult decisions relating to the directions of future research are needed if technology is to advance. For example: How feasible is the idea of creating alcohol with the aid of solar energy? Could gasohol profitably be made from alcohol which has been made from coal? What about biomass—could energy from this source economically change plant matter into alcohol? Research into gasohol historically has taken many directions. But the prospect of readily usable technology, not past investment in gasohol research, must determine the direction this research will take in the future.

Gasohol could potentially contribute to the solution of America's energy dependence on foreign nations. The challenge of gasohol is to help to create usable fuel where less existed before. In meeting this challenge, American agriculture faces a critical choice; it can proceed in one of two directions.

The first direction is to pay the price entailed in seeking a way to make gasohol work for the American people. This money is like risk capital. The research needed to develop the scientific, technological, and economic expertise which might bring gasohol to fruition requires a serious, expensive commitment on the part of American agriculture and the American people. And there is no guarantee of success.

The second direction American agriculture could take is to do less than the research that would be required to learn just how valuable gasohol could be to America. This second choice involves the risk of missing the opportunity which gasohol could represent. America could save the costs of research, of exploring ways that the system might be made to work. But if the potential does exist, and Americans fail to find it, then not only American agriculture but the entire country will be far more dependent on foreign nations than it would be otherwise.

America can well afford the first risk. It absolutely cannot afford the second.—***Robert W. Deimel***

AGRISEARCH NOTES

Susceptible Soybeans Suffer Losses

SOYBEAN VARIETIES susceptible to powdery mildew suffered yield reductions from natural infections of the disease in SEA tests at Ames, Iowa.

Plant pathologist John M. Dunleavy tested three susceptible varieties: Harosoy 63, Kanrich, and Bonus, and three resistant varieties: Lindarin 63, Wayne, and Cutler 71.

To provide a natural source of powdery mildew spores, Dunleavy planted a highly susceptible soybean variety, Corsoy, near the plots. He sprayed part of each research planting weekly with the fungicide benomyl.

The disease increased rapidly in July, and most leaves of the unsprayed, susceptible plants were infected. The unsprayed plots of Harosoy yielded 9 percent less soybeans than the plants protected by benomyl. Bonus yielded 10 percent less beans, and Kanrich yielded 15 percent less than the sprayed plots of the same varieties.

"Soybean yields from the resistant varieties were not affected by spraying, indicating that the higher yield from sprayed susceptible cultivars resulted from control of powdery mildew," Dunleavy said.

A field survey across central Iowa in 1975, when the disease first gained attention, found powdery mildew present in 19 percent of the fields, with 79 percent of the plants in each field diseased.

The 1975 outbreak prompted this agricultural research project to evaluate the effect powdery mildew has on yields, Dunleavy said.

Dr. Dunleavy can be reached at the Department of Botany and Plant Pathology, Iowa State University, Ames, IA 50011.—*R.G.P.*

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.